AVIATION

The Oldest American Aeronautical Magazine

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NUMBER 21

SPECIAL FEATURES

COMMERCIAL CROP DUSTING

THE LIMITING RANGE OF AIRPLANES

STABILITY AND CONTROLLABILITY OF AIRPLANES

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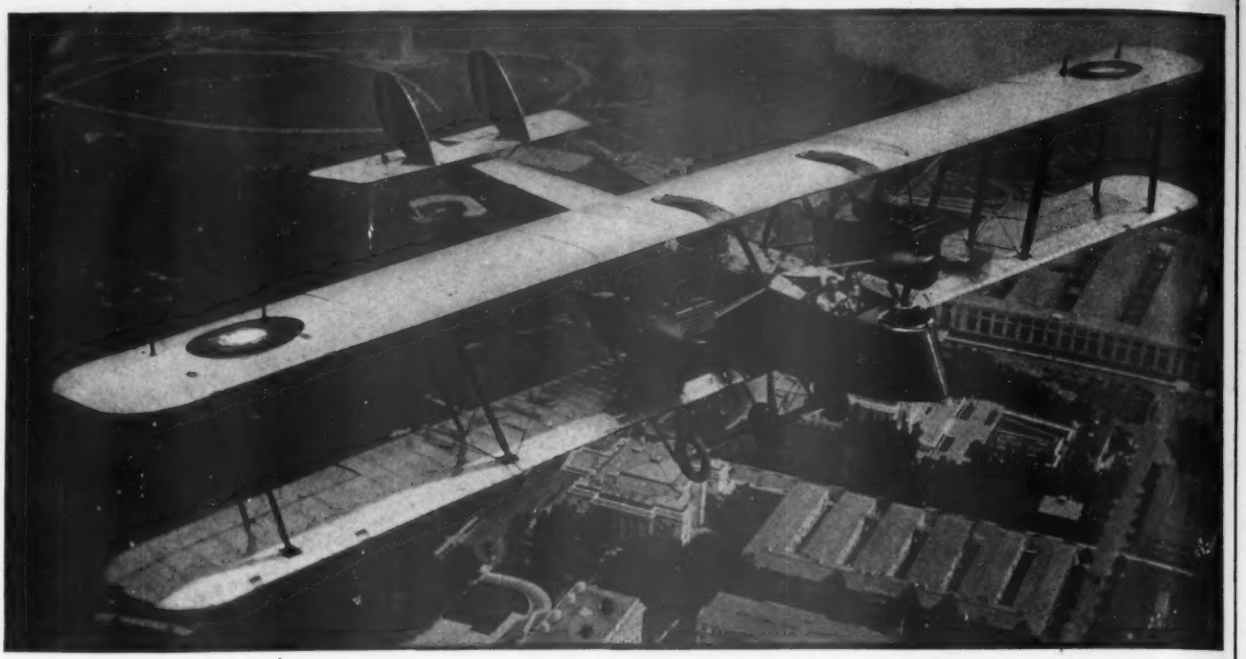

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MAY 25, 1925

AVIATION

VOL. XVIII. NO. 21

Published every Monday

CONTENTS

Editorials	569	The New Wright Cyclone	576
The Limiting Range of Airplanes	570	New York Organizing for Pulitzer Race	577
Cabinet for High Altitude Balloon	572	The English Stalling Demonstration	577
Commercial Crop Dusting	573	Proposed Airplane Tour	578
Small Air Cooled Engines	573	Russian Program	578
Stability and Controllability of Airplanes	574	Air Mail Proposals	578
German Touring Contest	575	A Correction	578
Schneider Cup Race	575	Airports and Airways	579
Maranville Goodrich Sales Engineer	575	United States Air Forces	580

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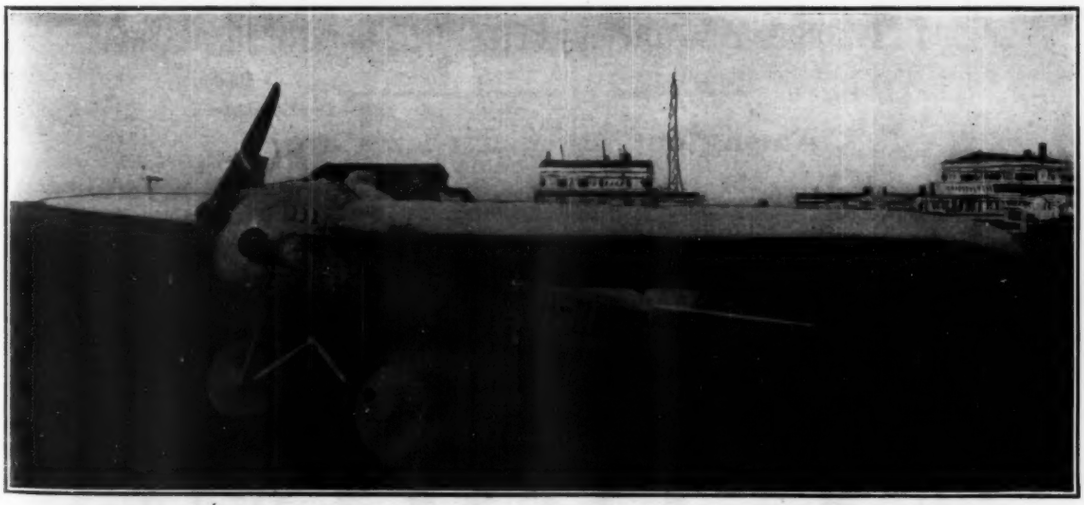
AEROPLANE WORKS — PANDER

THE HAGUE (HOLLAND)



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Fostering Development

IN a recent study of the interdependence of naval aviation and industry, the following statements were made: "The Navy has never undertaken the design nor the construction of an aircraft engine but has placed this matter in the hands of the aircraft engine industry of the country with a view to developing that industry for emergencies. The Navy has furnished funds for the development of new types of engines and has utilized its wide experience in operating engines for the development of new types and the refinement of proved types."

The Army and the Navy have divided the various sizes of engines between them. The engines now in use in both services were designed and built by civilian concerns. That the policy of giving the industry free rein, is sound, has been shown by its results. The United States leads the world today in aircraft engine development. We have engines ranging from sixty to eight hundred horsepower. These engines have enabled us to capture most of the world's records. Those that have been won away from us will probably be brought back by new engines, now in production or designed.

This policy is in direct contrast with the previous policy of the government departments in the development of aircraft. The development of aircraft had certainly not been "placed in the hands of the industry."

The Army Air Service has come to its present unfortunate position largely because it has tried to meddle too much with aircraft production and not have decisions on competitive trials of aircraft produced by the industry. Lately there has been a great change and the development of aircraft has been turned over to the manufacturers.

The Navy still clings to its own designs and close supervisions. In fact, the aircraft industry might almost be termed a fabricating shop for naval aircraft. The tendency, however, is to give the manufacturer freer opportunity to demonstrate his engineering skill.

The varying policies of the two services is only another of the indications that some more definite control is required over national aeronautical progress.

Airways

THERE is a gradually growing recognition even among the general public that more than airplanes are needed to establish an airline. Those who have watched the development of aerial transportation both here and abroad, realize that the improvements have been as great in ground organization as they have been in the aerodynamic qualities of the machines used. If this is true for day flying over level country it is even truer for night flying over mountainous country. This will become evident to those who have had the privilege of motoring through the Alleghenies and studyng the system of emergency fields and beacons which have been installed by the Air Mail. For night flying, this lighted airway is at the present time just as much a right of way as that owned by a railroad. Unless there is a great development in the navigation and reliability of planes, no company can hope to compete on the New York-Chicago run unless it uses the Air Mail route or makes a very large investment to develop another route.

A national policy covering airways will have to be made. Three methods present themselves. The first would create a complete government monoply with the government running the airlines. Another would provide for the selling or leasing of the franchise for exclusive use of a lighted airway to a private company. A third would provide for the maintenance of the airway by the government with free use by individuals or companies. It is the latter solution which seems the most practical, but there is much to be said for the other plans. It is obvious that in the beginning there will not be enough traffic to support the cost of maintaining several airways over a given route. At first either government or private monopoly of the airway will be necessary if the maximum of success is to be obtained. Later, when traffic becomes heavy, competition will follow naturally, as it has on river or ocean routes.

The New York-Chicago night airway will be the first test of a problem which has real national importance. Decisions are to be made which may have a very direct bearing on the future of air transportation in this country. It is fortunate that those in charge of the Air Mail have a keen sense of the relationship between national aeronautical development and the future of commercial aviation.

Safety First

THE statement so generally made that commercial aircraft can be transformed almost overnight into military types of transports and bombers will probably become less true as commercial types become more standardized.

The differentiation will probably come more in the direction of safety, comfort and convenience, three qualities that military aircraft need not possess. The tendency toward the passenger carrying airplane that will not go into a spin is most pronounced. It is a safe prediction that in five years no commercial type of airplane that is used for carrying passengers will be considered airworthy if it has not inherent aerodynamical qualities which prevent nose dives after stalling. This has probably been the cause of most of the fatalities resulting from aerodynamical defects.

Abroad, there is a decided trend toward "safety first." The planes of the Imperial Airways have been severely criticized for their aerodynamical deficiencies.

It is not too early to give this new development consideration. The time may soon come when regulatory laws will necessitate the designing of machines that can be stalled without danger.

The Limiting Range of Airplanes

By EDWARD P. WARNER

The subject of range, of the possible radius of action of an airplane, is one of the utmost importance. It possesses a certain sporting interest in connection with the making of records for distance flown without stop, and there have been times when the rivalry among the various builders and among the countries especially active in aeronautics has been intense, but limiting distance of flight as a characteristic has a very practical significance as well as a sporting one. The lines along which the naval use of aircraft is to develop will depend very largely on the distance over which the machines can be considered as self-supporting, and the dependence of airplanes on carriers and mother ships would decrease in direct proportion as the possible length of flight without refueling increased. Manifestly, too, the usefulness of very large bombers, too large to be operated from the deck of a carrier, will be almost entirely contingent on the ability to make continuous flights from a friendly base to the enemy's shores, or to the suspected location of his fleet, and back again to the point of departure. The ability to transport airplanes under their own power would be of the greatest importance in time of war, both in increasing the flexibility of the Air Service and the speed with which it can strike, and in reducing the burden on ordinary transport facilities. The ability to fly with regularity and certainty between the Pacific coast of the United States and the Hawaiian Islands, for example, or still better, from the United States to the Philippines via Honolulu and Guam, would be of the greatest value.

Commercial Range

The commercial importance of long distance flying is less striking than its naval value. The economic length of flight in commercial operation is far inferior to the maximum possible length. It may, however, be presumed that there is some relation between the two, and that if one can be increased the other will also show an upward tendency, so that where the maximum length of stage for economical operation is now about 300 mi., an increase to 500 or 600 might become practicable, and such flights as that straight across the Caribbean Sea from Cuba to the Canal Zone, too long to be considered at present, may come within the range of possibility for regular service.

The factors which affect range of flight may be grouped under three heads, aerodynamic, structural and power plant, with one or more sub-divisions under each head. The important aerodynamic characteristics are the lift/drag ratio for the airplane as a whole, substantially equivalent to the number of feet traveled horizontally for one foot of drop in the flattest possible glide, and the propeller efficiency. From the structural point of view the feature of interest is the ratio of weight of fuel and other expendible supplies which can be carried to the total weight of the airplane, and that ratio, in turn, depends in part upon the efficiency of design of the structure and upon the materials used, in part upon the load factors allowed for in making the design. Finally, there is the power plant, and the important element there is, of course, the rate at which fuel and oil are consumed per unit of useful work done, a consumption conventionally measured in pounds per horsepower hour.

The manner in which these several variables come into play easily develops from a superficial examination of the theory of long distance flight. The work done in driving an airplane through still air is equal to the product of the propeller thrust and the distance flown. The propeller thrust in level flight is, of course, found by dividing the total weight of the machine by the lift/drag ratio. The total work done at the engine shaft is equal to the required useful work divided by the propeller efficiency, or efficiency of conversion of the rotative energy available at the crank shaft into useful work in overcoming air resistance. The two aerodynamic factors are thus accounted for.

A unit of work done on the engine shaft represents a certain expenditure of fuel and oil, and that expenditure is, of course, dependent on the engine efficiency. The weight of consumable supplies used per mile of flight is therefore directly proportional to the weight of the airplane and to the fuel consumption per horsepower hour of the engine, inversely proportional to the lift/drag ratio and the propeller efficiency. For a given consumption of such supplies per unit of distance flown, finally, the maximum range will obviously be proportional to the weight of such supplies that can be carried, or, eliminating the total weight as a factor in consumption, the distance that can be flown by a machine requiring a certain expenditure of fuel to propel each ton of its weight for one mile will vary directly as the proportion of that ton of weight which can be given over to carrying the fuel that does the driving. In summary, the range of flight may be symbolically stated:

$$s = \frac{375\, w_f\, \eta\, L/D}{W\, \rho}$$

where W = gross weight, w_f = weight of fuel and oil carried, ρ = consumption of fuel and oil (lb. per horsepower hour) (the weight of such extra tanks as would have to be provided to carry an inordinately large amount of fuel, and therefore probably would not be included in the ordinary calculations of structural weight, should be allowed for in this figure), L/D = lift/drag ratio for the complete airplane, η = propeller efficiency, s = maximum range of flight in still air (statute miles). The figures introduced in this equation are, of course, for dimensional conversion of horsepower to mile-pounds per hour, etc.

To approximate future range, or limiting range of airplanes of various types at the present time, it is therefore necessary to estimate the limiting magnitudes of half a dozen different factors, which may be considered to some extent, although not entirely, independently of each other.

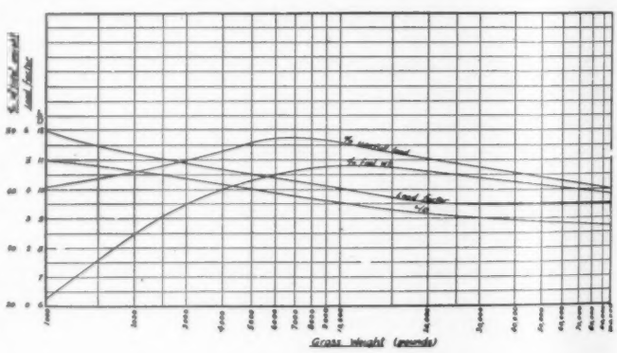


Fig. 1

The lift/drag ratio of a complete airplane at the present time seldom exceeds 9, and probably is not above 11 in any machine in actual service, although some of the German gliders, where weight of the structure is a matter of little importance, are reputed to show ratios in the neighborhood of 20. It is by no means difficult to design an airplane for which the lift under the most economical condition will be 12 or 14 times the drag, but it is a very difficult matter to do that without incurring structural disadvantages incommensurately large. The lift/drag ratio can be increased by increasing the aspect ratio, by eliminating external wing bracing, or by using a retractable landing gear. The first expedient leads rapidly into increased structural weight, as an increase in span of the spars and a decrease of their depth by a reduction of the chord is, of course, highly unfavorable to structural efficiency. The second possibility also means increased weight, as the use of a cantilever structure with a thin wing section, or the elimination of one or more points of external bracing attachments from an externally braced truss, increases

the bending moments to be carried, and requires a progressively heavier spar. Finally, the retractable landing gear, aside from the mechanical difficulty of working it out so that it will neither exact the use of a fuselage of increased dimension nor of a wing of exaggerated thickness or distorted form, also means added weight.

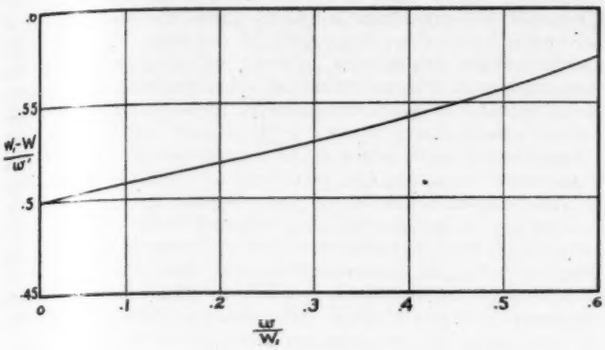


Fig. 2

The lift/drag ratio does not change very much with size, the usual tendency being to a decreasing value as the size increases, since the present practice of using separate power plants introduces through the nacelles more parasite resistance than is saved in the relatively smaller dimensions of the central fuselage. Also, it is impracticable to use on an airplane of 10,000 lb. weight as high an aspect ratio as can be employed on a light plane. Under present conditions, it is undoubtedly practicable to secure in a machine designed primarily for long distance flight a lift/drag ratio appreciably higher than those now general, and perhaps a relatively greater increase can be made in the larger machines than in the small ones. The *L/D* curve in Fig. 1 probably represents a fair approximation to the highest values which can be obtained for airplanes of various sizes in the present state of the art and without disproportionately large increase of structural weight.

Propeller Efficiency

The next factor, that of propeller efficiency, does not require the drawing of a curve, as it may be taken at the same figure for all sizes. The mistake has sometimes been made in calculating probable range of adopting the over-optimistic assumption that the propeller efficiency can be held while traveling under the most economical condition at the highest values that have ever been observed in wind tunnel test. Efficiency of course falls off with decreasing speed, and as the speed for maximum economy is comparatively low, it is impossible to attain efficiencies of 80 per cent or more, such as have sometimes been reached under more favorable conditions, and at a higher ratio of speed of advance of the airplane to peripheral speed of the propeller tip. Even with a variable pitch propeller, or with one designed especially for economical flight and without regard to other considerations, it is impossible to hope for better than 72 per cent on any really long range, and accordingly slow-flying machine, at the present time, and that will be taken as a standard figure.

As already noted, a factor fundamental in determining the ratio of fuel weight carried to total weight is the load factor for which the structure must be designed, and in that particular the large airplane fares better than the small one, as it is less likely to be violently maneuvered, is presumably less affected by minor irregularities of atmospheric structure, and can therefore be made with a relative strength less than the minimum which would be necessary for safety in the small machine.

The minimum load factors which can be considered as safe as a basis for analysis at a high angle of attack have also been plotted in Fig. 1. It will be observed that the value falls off steadily with increasing size, up to a weight of something over 20,000 lb., and that the decrease then stops quite suddenly. Manifestly, there is some factor below which no airplane, however large, should go. The true factor of safety in a very large machine ought to be at least 1.6, and even though there is to be no maneuvering, beyond the gentlest of turns and climbs, "bumps" and gusts may throw on the structure a load of at least twice the weight. A factor not lower than 3, and preferably somewhere around 3½, should therefore be taken as an absolute minimum.

For a given load factor the ratio of weight of structure to total weight is certain to increase with increasing size, beyond a certain point well down in the scale of sizes now used. The only escape is found in a great increase in the amount of external bracing, and that cuts the lift/drag ratio at a rate even more rapid than is allowed for in Fig. 1. As the power plant weight remains very nearly proportional to the horsepower, little saving in unit weight being made in existing engines by increasing power output, the percentage of weight allotted to the fuel inevitably falls off with increase of size. The only structural advantages of the very large machine lie in the possibility of distributing the weight of power plants, fuel, etc. more uniformly over the wings, an expedient which seriously increases the landing stresses while reducing those in flight, and in the lowered percentage of total load which must be allotted to the carrying of the crew, navigating instruments, etc. In a light plane the weight of the pilot forms a very large proportion of the maximum possible useful load, while in a machine carrying 40,000 lb. the weight of the crew is insignificant. That effect becomes really important, however, only in very small sizes. As between the moderately large and the very large airplane it amounts to little. The gain in efficiency of structure, as more complex arrangements of bracing become practicable with increasing size, also ceases to be of importance after moderately large sizes are reached, and the ratio of useful load to total load, increasing at first with growing size, begins to fall off after a certain point, which the writer believes will be found in the neighborhood of 10,000 lb. gross weight, is reached. The two remaining curves in Fig. 1 give the percentage of the total weight which is likely to be available for useful load and that more restricted percentage which can be allocated to the carrying of fuel and oil and extra tankage. These curves are based on an assumed load of 25 lb. per hp., which probably approximates to the figure permitting the development of maximum flight range. If the load per horsepower is reduced, thus increasing the weight used per hour but also increasing the speed, the percentage of the total weight which must be given over to the power plant causes a reduction in the fraction available for fuel, and if a change in the other direction is made the wing loading is necessarily reduced to a point where the fuel weight suffers in behalf of that of the structure.

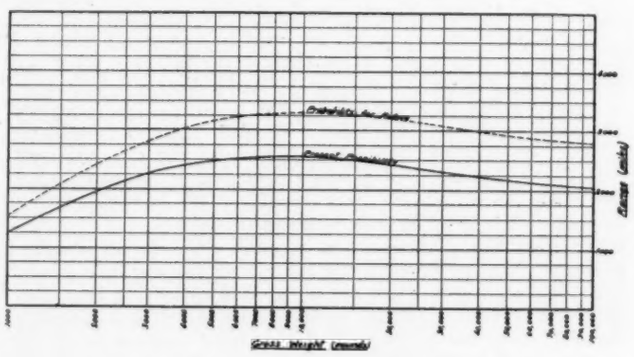


Fig. 3

There remains only one variable, the unit fuel consumption. Engines have of course been built which bring this figure well below 0.45 lb. per horsepower hour for the fuel alone, and below 0.03 lb. for oil, but such efficiencies are attained only for one particular throttle setting, and it will be necessary in making a flight of maximum length that the throttle setting be varied in order to operate always at greatest economy as the weight carried changes. 0.47 lb. per horsepower hour will then be an excellent figure for fuel consumption, with 0.03 for oil and 0.06 to allow for the extra tank capacity, making a total of 0.56 lb. per horsepower hour of expendible supplies.

The full range of flight can be calculated directly from these data. It is necessary that some method of allowing for the effect of change of weight be arrived at. The effect of this variation has been the subject of exhaustive analysis in such papers as those of Coffin and Renard, but it is impossible here to arrive at a rough approximation amply sufficient for present purposes.

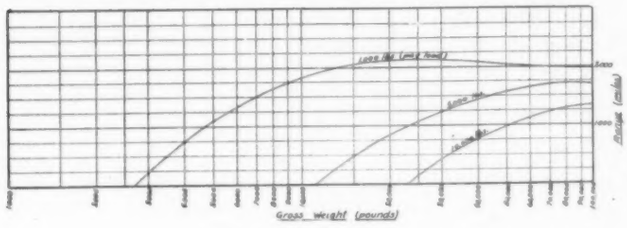


Fig. 4

The only remaining problem precedent to the calculation of actual range of flight is the decision on the average value to be used for weight during the flight. The weight may be 40 per cent less at the end than at the beginning, and some value intermediate between the initial and final figures obviously should be employed in the calculation. An arithmetic mean of the weight at the beginning and the end of the flight does not suffice, as the fuel consumption is more rapid in the early stages than in the later ones. The arithmetic mean would therefore be reached sometime before the flight was half over, and the true mean is less than the arithmetic.

The process of calculation need not here be followed through in detail, but it is easy to show by integration that the mean weight may be taken, assuming the lift/drag ratio, propeller efficiency etc. to remain constant throughout the flight, as equal to:

$$W = W_1 \frac{w^1}{w^1 + \frac{w_1^2}{2} + \frac{w_1^3}{3} + \frac{w_1^4}{4} + - -}$$

where w^1 is the percentage of the initial weight carried in the form of fuel and oil. This percentage, of course, should not include the weight of the extra tanks, as they have to be carried throughout the flight. W_1 is the initial weight, and W the average weight to be used in the calculations. In Fig. 2 there is plotted a curve of the proportion of fuel weight which is to be subtracted from W_1 in order to secure W. It will be observed that, for the reasons just given, this proportion slightly exceeds 0.5.

The calculation of range can now be made directly, and the curve of maximum range (in statute miles) against size of airplane is given by the lower line in Fig. 3. This curve is based on the data plotted in Fig. 1 and on the propeller efficiency and fuel consumption decided upon earlier in the paper. It does not necessarily represent the absolute maximum of what might be accomplished, but it is unlikely that the range shown by the curve could at the present time be exceeded with any airplane designed to serve for any purpose other than the making of a record. It will be observed, however, that the present world's record for distance covered without stop and without refueling in flight, 2,516 mi., comes within 2 per cent of lying on the curve, which was calculated directly from aerodynamic and structural data selected with no reference to this or any other particular record, and that the record was made by a machine having a total weight substantially equal to that corresponding to the peak of the curve.

To project such a calculation as this into the future is dangerous, for the discovery of a new material or some unanticipated development in aerodynamics may upset the work entirely, but a guess may be made at what now seems most likely to be accomplished within a comparatively brief time, say ten years, and on the assumption that airplanes will continue to develop along their present lines without radical change of form. On that assumption, it is reasonable to expect a 5 per cent increase in propeller efficiency, an improvement in L/D ranging from 5 per cent in the small machines to 15 per cent in the largest covered by the curve, and an increase in the amount of fuel carried running from 10 per cent in the smallest airplane to 15 per cent in the largest. A new curve of range has been calculated on these assumptions, and is included in Fig. 3.

It is natural to extend a discussion of the question of absolute maximum range over the question of maximum radius of action with a given useful load, commercial or military. The maximum length of flight has been calculated for useful loads, other than fuel, oil and crew, of 1,000, 5,000 and 10,000 lb., respectively, and the results are shown by the three curves in Fig. 4. It will be observed that the ultimate range falls off comparatively slowly as the load is increased, but the size of machine to be used to secure the longest flight quickly increases to a point far outside the range of present experience. Incidentally, these curves make it clearly apparent that it would be an easy matter to break existing records for distance with 250, 500 and 1,000 kg. of useful load, which now stand at 684, 590 and 248 mi. respectively. Even without going into airplanes of more than 12,000 lb. gross weight, it should be possible to raise those figures to approximately 2,100, 1,800 and 1,300 mi. The day of over-sea bombing raids at a distance of more than 1,000 mi., or of anything in the nature of commercial operations over a non-stop route having a total length of more than 600 or 800 mi. at the outside, is, however, far distant.

Cabinet for High Altitude Balloon

The figure below shows the cabinet for the 80,000 cu. ft. spherical balloon being constructed for the Army Air Service by the Eberhart Steel Products Co. The cabinet is made of 0.125 in. sheet aluminum with glass ports of double thickness to prevent fogging and is intended to maintain an internal pressure of 10 lb./sq. in. for a period of one hour with a factor of safety of two. The floor is about 14 in. from the bottom and the space between is used as a ballast compartment. Lead shot being used in this case and controlled by a special valve operated from within the car. The rip cord and valve controls are brought inside the car through stuffing boxes. The door operating mechanism is so designed as to permit instant opening for unobstructed egress in the event of emergency.

Commercial Crop Dusting

Details of the Operations of the Huff Daland Dusters

By ROGER WILLIAM RIIS

During the past few months, commercial aviation took a notable stride forward in the launching, on an entirely commercial basis, of crop dusting by airplane. This general subject has been treated and maltreated in the press for many months. It has even been debated in the House of Representatives, where, however, it received the stamp of approval.

This subject is actually very simple and direct. Down in Tallulah, La., the United States Department of Agriculture maintains a research station known as the Delta Laboratory. This Laboratory is in charge of Dr. B. R. Coad. Four years ago, Dr. Coad conceived the idea of spreading poison on crops by use of airplanes, and he worked on this idea for two years with the assistance of planes loaned by the U. S. Army. Two years ago, however, he came to the conclusion that a specially built airplane was necessary. The hopper and spreading apparatus had to be built into the fuselage, and, still more important, the peculiarities of this type of flying (so near the ground, amid trees, in hot climates, etc.) called for a new design of ship. So Dr. Coad requested the cooperation of the Huff Daland Aero Corp. Representatives of this firm have been working at Tallulah since 1923, and have succeeded in producing a special dusting ship, different in vital respects from any airplane previously built.

Company Formed

This company, with Dr. Coad's approval and interested advice, organized the Huff Daland Dusters, Inc., with southeastern headquarters in Macon, Ga., and it is this dusting concern that is operating eighteen ships in Southern cotton fields this year.

The plan of operation presents many interesting details that have had to be worked out with considerable care. The eighteen ships will be quartered at nine different localities, two in each place. Of these two ships, one will be perpetually in reserve while the other is on actual dusting duty. Pilot and mechanics will settle down and live in the near-by town.

These localities were not picked at random. The writer personally investigated many potential bases, and other representatives of the company investigated many other bases. In all, more than forty tentative locations were looked over, the citizens were interviewed and the cotton fields surveyed, both from the ground and from the air.

Thirty or more of these places have been eliminated for one reason or another, and by this time the final nine will have been chosen. One will, of course, be the city of Macon.

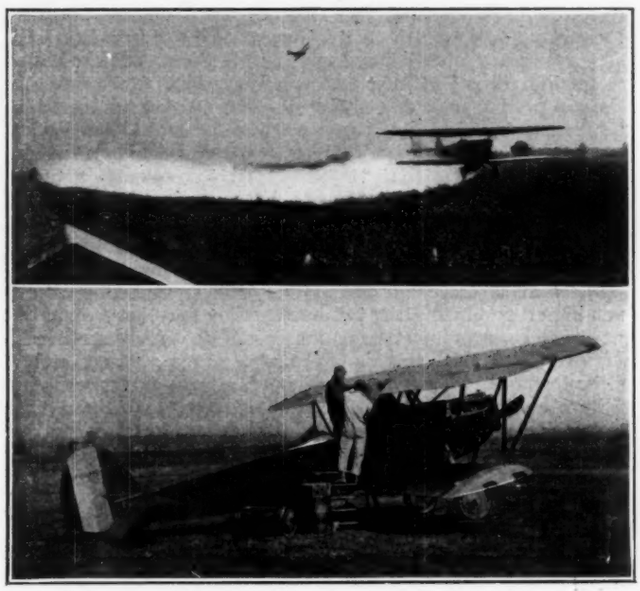
New Flying Field

In passing, it will be of interest to know that the Chamber of Commerce of Macon has built for Huff Daland Dusters as fine a flying field and hangar as can be found throughout the South. The field is a four-way field, five miles south of town, with a long run of 600 yd. This was the field used by the 1st Pursuit Group in their Canada to Florida flight in February.

The chief of operations is Lieut. H. R. Harris, for the last five years chief of the flying section of McCook Field. Lieutenant Harris is well known to all fliers, but not yet so well known is the fact that the War Department has released him for a year to Huff Daland, to take charge of a work which the War Department recognizes as of vital importance both to aviation and to agriculture.

Lieutenant Harris has recently visited several of the Army fields and has picked twelve pilots and half again as many mechanics. Among those who have already reported for duty are Dan E. Tobin, N. L. Cote, Eugene Stefens, George Ott, Arthur Gray, Elliott Dunn and Douglas Culver. The last-named will be chief of Maintenance. He has been with Lieutenant Harris at McCook for several years.

The total acreage of cotton that will be protected by airplane this year will be about 60,000 acres. Each airplane base will take care of 6,000 to 7,000 acres in its vicinity. The planes will remain at the bases until the cotton is picked, because from three to five or even six applications of calcium arsenate must be made during the summer.



A view of the Huff Daland Duster in action and the machine being loaded

The service is sold to farmers on contract, at a price of $7.00 per acre for the five applications. This figure includes the cost of the poison and several other features which are of greater interest to farmers than to aviators. One of these features, however, serves to indicate the confidence that the best authorities repose in the work; one of the Aetna affiliated insurance companies has announced a cotton insurance policy that, for the first time, offers protection against the boll weevil as well as other risks. This policy is being written only in connection with the work of Huff Daland Dusters.

During the past month, the airplanes have been actively engaged in dusting some of the millions of peach trees that make Georgia beautiful in the spring. This work has been extraordinarily satisfactory to the peach growers. It is a noteworthy fact that airplanes can dust peaches and pecans and pine forests and cotton and, in fact, any crop that has a disease and a remedy for that disease. It is also noteworthy, however, that the work is not done with airships; nor can it be very successfully done in country like New England, where the hills are too abrupt and the acreages too small to suit the high speed of an airplane in action.

Small Air Cooled Engines

The Wallace Kellet Co. of Philadelphia, who represent the Anzani motors in this country, report a continued demand for both the six cylinder 70-80 hp. engine and the 30-35 hp. three cylinder engine. In France where the competition of war surplus engines is not so severe both these engines are widely used. Last year the 70-80 hp. engine won the French Touring Plane Contest and the three cylinder engine won the light plane contest. In spite of the 40 per cent duty and the freight charges the six cylinder model is reasonably priced in this country and there is no doubt that with the decrease in the number of OX engines that this efficient type will gain in popularity.

Stability and Controllability of Airplanes

Part VIII. Concluding Remarks

By B. V. KORVIN-KROUKOVSKY

The airfoil sections employed for the wings of airplanes have great influence on their spinning qualities. We will remember that spin occurs after stall essentially due to autorotation, and autorotation occurs due to quick drop of the lift after burble point. The airplane will be more spinproof therefore, the slower the lift coefficient curve drops after stall, and the more rounded it is at the burble point. The so called "high lift wings" of moderate and very thick variety usually show a well rounded peak of the lift coefficient curve in laboratory testing, and, as a matter of practical observation, have less tendency to spinning in actual airplanes. They also contribute indirectly to safety from accidental spin by having the burble point at very large angle of incidence—from 20 to 25 deg. measured from the angle of zero lift. It must be a very careless pilot indeed not to notice that he is stalling the machine at 20 deg. of angle of incidence.

We said at the beginning of this chapter that ailerons are not important during the tail spin. They may have some importance however in starting the spin. A very common case of involuntary tail spin is one arising from the turn at low altitude either in the approach for landing, or after engine failure on the take off. The pilot attempts to make a turn at nearly stalling speed and in due time moves the controls to right the machine. At this time the *lift effect* of the ailerons is practically absent, while the drag of the lowered aileron makes the airplane yaw in the direction of the original turn and provokes a spin. The washed-out or differential acting ailerons would tend to yaw the airplane in the opposite direction, so as to stop the turn, and by so doing may prevent the spin from taking place.

The Tailspin

The author does not feel justified in giving more space in this paper to the question of tail spin, as this question is rather loosely connected with the lateral stability of airplanes. The information given above is sufficient to show that stability in roll has very little to do with the tail spin, while the stability and damping in yaw are of utmost importance. We will emphasize again that the whole question of the tail spin comes into being only after the airplane is stalled, and while it is kept stalled by the action of elevators. As soon as the elevator is released and the angle of incidence is reduced below the stalling one, damping takes the place of autorotation and very quickly stops the rotation of the airplane.

Occasionally we hear rumors that some airplane does not come out of a tail spin. In most cases such rumors are greatly exaggerated as few pilots dare to pursue the testing of such an airplane far enough to gain exact information on the subject. As far as we can see there are but two causes which can produce such an effect. The first cause—aerodynamical—is location of the center of gravity too far back, resulting in pronounced longitudinal instability. When stalled, such an airplane has a tendency to stall still further. This tendency may be stronger than the opposite action of the elevators, in which case the airplane will remain stalled despite all the pilot's efforts, and therefore will continue spinning. Whether such a condition is likely to take place can readily be ascertained by checking the position of the center of gravity and the degree of stability by the method described in Appendix I to this paper, or by a wind tunnel test. The second cause—structural—is insufficient strength or rigidity of the wings allowing them to warp into a helical shape and to thus produce an effect somewhat similar in appearance to autorotation.

We stated at the beginning of this paper that our aim is to give sufficient qualitative information to enable one to form a diagnosis as to the nature and basic cause of any trouble in regard to lateral stability and response to the controls of an airplane. This we believe is accomplished by the explanations given above. Our second aim, directely derived from the first one, is to determine what combination of properties is most desirable for the airplane in regard to its lateral behavior. This question resolves itself in two parts—behavior with hands off and response to the controls. Generally speaking we want to obtain an airplane requiring the least attention of the pilot in normal flight, yet maneuverable and responsive to the action of controls. It is desirable to make the airplane steerable essentially by the rudder, as this is the most natural way and is in common with other methods of transportation. Steering by the ailerons alone is not natural, and is difficult to learn for the beginner. This is well illustrated by the tendency observed among students in flying schools to use excessive rudder and not sufficient bank in turns.

Stability in Roll

The explanations given in the body of this paper are sufficient, we believe, to show that there is absolutely no harm and a good deal of good in providing plenty of stability in roll. This definitely prevents spiral instability, and improves the ability of an airplane to hold its direction. The maneuverability is much increased as *high stability in roll can be utilized to roll the airplane* by the use of the rudder and differential ailerons. The ailerons become less important, can be reduced in size and their design is therefore simplified.

Stability in roll is obtained essentially by dihedral of the wings, and we can say that a dihedral of 4½ deg. for an aspect ratio of 5½ and of 3 deg. for an aspect ratio of 7 (SE5 and DH4 airplanes respectively) was not found excessive.

Damping in roll depends entirely on the aspect ratio of the airplane, which is determined usually on consideration of weight and efficiency of wings, rather than stability. Generally, airplanes of higher aspect ratios, roll slower, and therefore feel steadier and easier to fly. This slowness of roll is not sufficient to impair the maneuverability of the airplane in ordinary flying, and may be objected to only in stunting.

Stability in yaw must not be too high, or the sensitiveness of controls will be seriously impaired. High stability in yaw will also make the airplane yaw badly in rough weather and will make it feel less stable laterally than one with moderate stability in yaw. A high degree of damping in yaw is very desirable for greater steadiness of motion and as a spin preventitive measure. The rudder control must be as powerful as possible as it is used indirectly to control the roll, and also because it is the only control left at the pilot's disposal at very low speed and after stalling.

Stability in Yaw

The requirements of powerful rudder control and heavy damping in yaw conflict somewhat with the requirement of moderate stability in yaw. These requirements can be satisfied by providing large fin-rudder area, and by partly counterbalancing it with sufficient fin area in front of the center of gravity. Such area is naturally obtained in twin engined commercial airplanes where half of the passengers' cabin and both engine nacelles project forward of the center of gravity. It is also readily obtained in high powered airplanes of smaller size, such as army two seater observation airplanes, particularly if nose radiators are used. In case it is not convenient to provide large fin area in front as is often the case with low powered and rotary engined airplanes, excessive stability in yaw can be avoided by making the fuselage shallow, rounded or converging to a horizontal knife edge stern, thus confining the empennage effect to the actual fin and rudder. This is generally not very desirable as it does not provide enough damping in yaw, but must be resorted to if the airplane is inclined to spiral instability due to lack of

dihedral in the wings. It may be used also in fast scouts where high damping is not desired and the maneuverability must be secured at all costs. Examination of the Fig. 16 will be found very instructive in this connection as the fuselages shown, with exception of JN4, belong to machines credited with excellent handling qualities and maneuverability.

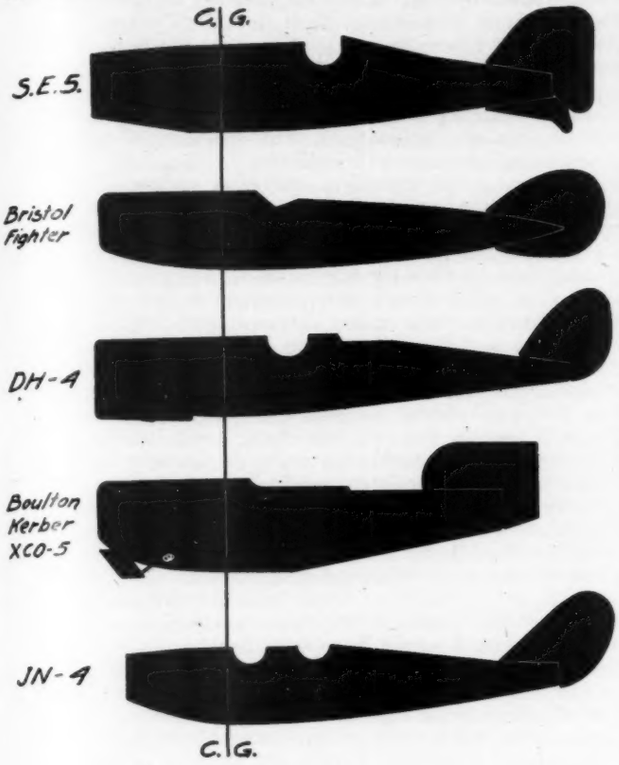


Fig. 16

Our lack of quantitative knowledge and uncertainty of design in regard to lateral stability is partly redeemed by the fact that lateral stability, unlike longitudinal, depends entirely on the external characteristics of the airplane, essentially on the dihedral of the wings and on the area of the vertical empennage, both of which can be readily altered. It is very easy to provide in the design of the wing fittings, for a possible variation of, say, plus or minus two degrees in dihedral to be obtained in rigging, and to design an experimental airplane with two or three interchangeable fins, as the fin is a very simple and inexpensive part of an airplane. The best proportion of dihedral angle and area of the vertical fin can be determined then by flight tests. If the rudder is ineffective, the machine steers by the ailerons and these are stiff, and the tendency to overbank is observed—more dihedral angle and less fin area should be used. If the rudder is too sensitive and causes severe rolling of the machine, and the tendency to unstable oscillations in roll and yaw is observed in flight with hands off—the fin area must be increased and the dihedral may be decreased in extreme cases. These cases are, however, very rare.

German Touring Contest

A sporting competition on a very ambitious scale is to take place in Germany during the ten days beginning May 31. 350,000 marks ($83,300) have been subscribed to the prize fund, and the contest will be supervised by the Aero Club of Germany.

The contest is open to three categories of machines: A, not exceeding 40 hp., B, not exceeding 80 hp., and C, not exceeding 120 hp., so that the whole affair is for machines of very modest power.

The competition involves five circular flights each of approximately 685 mi. each starting from and ending at Berlin, and in total covering practically the whole of Germany.

The first flight, May 31-June 1, is over the route Berlin - Schwerin - Hamburg - Altona - Bremen - Munster - Cassel - Magdeburg - Berlin. "A" machines (under 40 hp.) must land at Schwerin and Munster, "B" machines (under 80 hp.) at Hamburg and Cassel, and "C" machines (under 120 hp.) at Bremen and Magdeburg.

The second flight (June 2-June 3) is from Berlin via Hanover - Padeborn - Frankfurt - Darmstadt - Gotha - Weimar - Chemnitz - Dresden to Berlin. Compulsory landing places are:—"A" machines, Hanover and Darmstadt, "B" machines, Padeborn and Gotha, "C" machines, Frankfurt, Weimar and Dresden.

On June 4-5 the route is Berlin - Dessau - Erfurt - Wurzburg - Stuttgart - Bamberg - Hall - Berlin, and the compulsory stops:—"A" machines, Dessau and Stuttgart, "B" machines, Erfurt and Bamberg, and "C" machines, Wurzburg and Hall.

On June 6-7 the route is Berlin - Naumburg - Nurnberg - Augsburg - Munchen - Hop - Leipzig - Berlin, with compulsory landings at:—"A" machines, Naumburg and Munchen, "B" machines, Nurnberg and Hof, and "C" machines, Augsburg and Leipzig.

The last flight (June 8-9) is Berlin - Gorlitz - Breslau - Frankfurt (on Oder) - Stettin - Stralsund - Rostock - Berlin. The compulsory stops are:—"A" machines, Gorlitz and Stettin, "B" machines, Breslau and Stettin, "C" machines, Frankfurt and Rostock.

All machines must be built in Germany, but foreign engines are admissible. The chief prizes are:—

The B. Z. (Berliner Zeitung), open to classes A and B only, of 100,000 marks ($23,800) divided into 25,000 marks, 15,000 marks and 10,000 marks, in each of the classes. This will be awarded on a formula which is essentially a reliability measure.

The Boelcke Prize, open to class C only, is of 50,000 marks ($11,900), and is awarded on a similar basis to the B. Z. prize.

The Otto Lilienthal Prize of 105,000 marks ($24,990), will be awarded on an all-round performance basis of a general nature, not unlike the British Air Ministry's Light Airplane Competition.

The Richthofen Prize of 45,000 marks ($10,710) will be given for the best performance by German engines in the B. Z. and Boelcke competitions.

The German Aero Club has in addition to the prize money a sum of 400,000 marks ($95,200) for the purchase of airplanes of under 70 hp. entered for the competition.

Up to April 1 no less than 86 entries had been made to the Aero Club.

Schneider Cup Race

The entries for the Jacques Schneider Cup Race closed on April 1, 1925. This contest will be conducted at Bay Shore Park, Baltimore, Md., Oct. 23 and 24, 1925. The following entries have been received: United States 3; England 2 and Italy 2.

Maranville Goodrich Sales Engineer

A. G. Maranville recently was appointed as sales engineer for the Aeronautical Sales Division of the B. F. Goodrich Rubber Co. Mr. Maranville was formerly connected with the Engineering Department of the Goodrich Co. and had charge of aeronautical design. He has been distinctly associated with many aeronautical developments in the several years that he has been in this work. During the World War he was responsible for many mechanical designs used extensively in lighter-than-air craft. He is a licensed pilot for both airships and free balloons.

Mr. Maranville has a wide acquaintance in the aeronautic field. His engineering experience has covered both the lighter-than-air and heavier-than-air branches of the industry. He will be associated with Henry Wacker, director of Aeronautic Sales, at the Goodrich offices in Akron for the time being.

The New Wright "Cyclone"

The new 450 hp. Wright "Cyclone" engine recently announced by the Wright Aeronautical Corp. is the latest of a long line of engineering accomplishments by this company since the first successful flight by the Wirght Brothers some 21 years ago.

The "Cyclone" is a nine-cylinder air cooled engine with the cylinders arranged radially from the center line. By a novel design of valve and cylinder arrangement the diameter of the engine is reduced to a minimum. This feature is noteworthy as otherwise if the diameter were too large the gain in elimination of resistance of the water radiation might be offset by the resistance of a larger diameter engine.

The cooling by air which has been successfully utilized on smaller aviation engines for many years is accomplished by fins on the cylinder sides and heads. To obtain the full measure of the advantages of air cooling and yet obtain an engine more powerful than the 400 hp. Liberty was a task made possible only through the experienec gained in building hundreds of smaller air cooled aviation engines. These engines have now successfully passed the series of duration and high power tests required by the Navy and are now being started on a series of flights to determine exactly the increase in performance over the Liberty engine.

The major principle utilized in this engine accomplishes five purposes of basic importance in aviation. It saves weight by eliminating the water radiators formerly required together with their piping shutters, pumps and supports. It eliminates the resistance of these radiators to the flow of air. It is safer to fly than the old water cooled system. The first cost of the plane is decreased by the elimination of many expensive items. The operating costs are lower. The outstanding importance of these air cooled features can best be realized by comparison of the new air cooled engine with the Liberty engine which is of water cooled design.

The resistance to the air set up by water radiators has long been a problem for airplane designers. For a Liberty the radiators are several times the size of the largest automobile radiator and when the shutters which regulate the water temperature in these radiators are closed they offer the resistance of many square feet of flat plate surface to the advance of the plane. With the air cooled "Cyclone" this resistance is entirely elemental and the power of the engine is available to pull the plane at a higher speed. The elimination of this radiator head resistance can thus be used for increasing speed or maintaining the same speed with less horsepower, and thus less fuel.

It is safer to fly with an air cooled engine as one of the fruitful sources of forecd landings with water cooled engines is a leak in the water system. Leaks in the water system in planes are more frequent than in automobiles, as the systems are large, built of the lightest materials and subject to rapid temperature changes and vibration. Many will remember that Lieutenants Kelly and Macready before their final successful transcontinental flight was accomplished, had one preliminary flight absolutely terminated by a water leak in their water cooled Liberty.

Water systems are very vulnerable to bullet fire, whereas the "Cyclone" air cooled engine, even if one or more cylinders were hit, would probably still function with only slightly impaired efficiency.

The cost of operation is less with the air cooled engine because of rapidity with which minor inspections, adjustments and repairs can be made. This readiness with which these service operations can be made on the "Cyclone," decreases flying costs two ways, one by decreasing lost flying time when a plane is out of commission for engine inspection or adjustment, and secondly by making it easy to service the engine. The operator will not procrastinate on the required inspections and adjustments, thus decreasing flying costs by decreasing breakages and accidents.

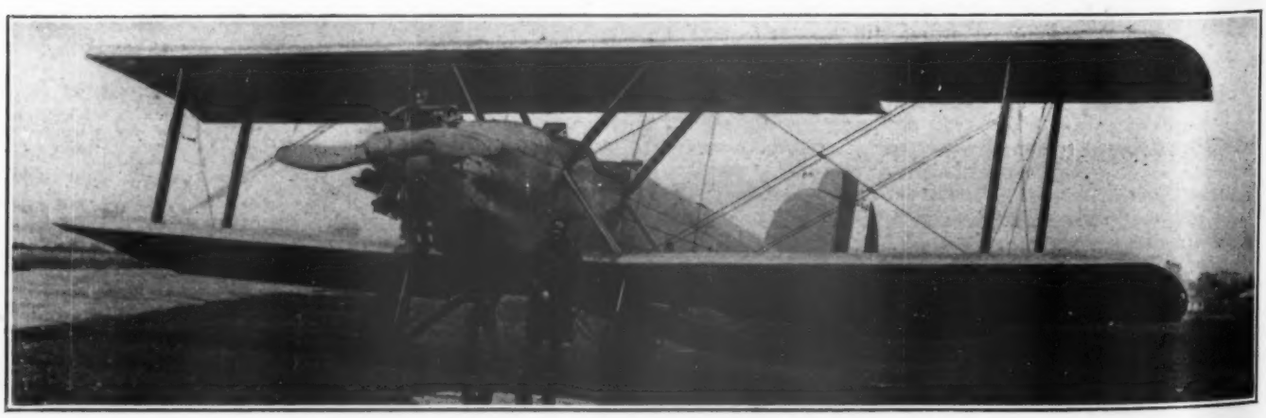
Thus to grind the valves and clean carbon on a Liberty, it is customary to remove the engine from the plane, to remove all cam shafts and valve mechanisms, and when reassembled the valve gear must be re-timed. This involves about two days's work for two men, whereas with the "Cyclone" a cylinder may be removed in a few minutes work, valves touched up, carbon removed, and rings and pistons examined and the cylinder put back without disturbing the timing or taking the engine from the plane. Then when another opportune time comes the process may be continued on the next cylinder. In this way the "Cyclone" can be constantly kept in the very best flying condition, whereas with the water cooled engine the universal tendency is to put off such work until absolutely required.

For the trial flights of this Wright "Cyclone," as the new engine is called, it was installed in the plane formerly powered with a Liberty. The "Cyclone" although it has approximately the same cylinder displacement as the Liberty, saves 285 lb., in the weight of water, radiator, shutters, pumps and piping. The weight of the plane necessary to carry the additional weight would be approximately 140 lb. or a total saving of about 1 lb. per hp. for the complete plane. In other words, the new "Cyclone" engine could either carry 400 lb. more useful load of mail, express, passengers or bombs than could the Liberty or the power formerly required with the Liberty to lift and fly this 400 lb. dead weight, can with the air cooled "Cyclone" be utilized for increased climb, speed or altitude.

Some of the additional advantages of the "Cyclone" over the Liberty as evidenced by these recent trial flights, are improved vision for the pilot, no possibility of damage from freezing, warms up more quickly after being started. The "Cyclone" being exactly 2 ft. shorter than the Liberty releases that much space in the plane for additional passengers, cargo or fuel.

The engine is equipped with two AG-9-D Scintilla Magnetos, a description of which appeared in the March 16 issue of AVIATION.

One of the features of this magneto that appeals particularly to the aircraft power plant designer, is the extremely light magnetic pull of the rotor. In consequence, little power is required to drive it, and the absence of the jerking effect common to other magnetos, prolongs not only the life of the engine drive gears, but the magneto gears themselves.



The Wright "Cyclone" fitted to a Navy Douglas DT6

New York Organizing for Pulitzer Race

At the meeting of the National Aeronautical Association recently held in St. Joseph, Mo., the 1925 Pulitzer Race was awarded to New York provided that that city could raise the necessary guarantee funds. It is too early to make a positive announcement that the race will be held in New York but according to Mr. McDonnell, president of the New York Chapter of the N.A.A., satisfactory progress is being made in the organization of the finance committee and the raising of the guarantees necessary. A general committee of prominent New Yorkers is being formed as a preliminary to the naming of the committees which will handle the various phases of the work.

The proposed course has been flown over by Army officers who came up from Washington and reported it to be entirely satisfactory. It lies for the most part over very flat country and there are many large open fields available for emergency landings. The construction of the two new racers which are being built at the Garden City plant of the Curtiss company is progressing rapidly and embodies much that they have learned from their previous racing experience.

Long Island offers great opportunities for a large air meet. Mitchel Field is 22 mi. out from New York but there are good train connections and many motor roads running by or near it. The field itself is very flat and large enough to handle the racers. There are sufficient hangars to handle the visiting Army ships and several meets of considerable size have been held there before. Alongside the field is the grand stand of the Meadow Brook Polo Field capable of holding over 30,000 people. It has been suggested that this might be the start and finish of the race with the machines flying between the two grand stands.

Within a quarter of a mile of Mitchel Field is a very large commercial field one end of which is called Curtiss Field and the other end Roosevelt Field. This would give an excellent opportunity to hold a civilian meet entirely independent of the military field but yet near enough so that the crowds attracted by the Pulitzer race would also visit the commercial exhibitions.

The English Stalling Demonstration

On April 15, at the Croydon airport, London, there was held a demonstration of control at stalling speed. There were two machines taking part, a Fokker FVII and an Avro 504 fitted with Handley-Page slots,. Great interest was shown by the English press and the trade. The day was quite unsuitable, there being a 40 mi./hr. wind blowing which tended to exaggerate the slow speeds. This demonstration was originated by Fokker and the Avro was brought over from Farnborough in response to requests from interested persons that England be represented.

The first machine to go up was the Avro piloted by Flight Lieutenant Bulman. The take-off was spectacular in the extreme, the high wind enabling it to leap off the ground after a run of only a few yards and to show an extraordinary climb. By the time the machine had reached an altitude of 100 ft., it was practically sitting still and at a very high angle of incidence. A slight roll from side to side was noticeable but the machine was obviously well under control. Having hovered, or drifted backward, for a minute or so, the pilot pulled the machine around with the tail still way down and did a banked turn that normally would have resulted in a complete stall and tailspin and very probably a crash owing to his low altitude. During this turn, and other similar turns, the pilot used his rudder in the normal manner and not to overcome the drag effect of the ailerons, as in a normal machine.

The Avro was fitted with the Handley Page slots on the leading edge of the wings opposite the ailerons only. The slots were arranged to act in conjunction with the ailerons; opening when the aileron was lowered and remaining closed when it was raised. This permitted the aileron control to be effective as a lifting force even at stalling speed and in this way to overcome the drag effect, which is the more powerful at stalling speed with the normal type.

After the Avro landed, Mr. Fokker took aboard nine passengers and took off in about the same space and with the same climb as the Avro. After reaching an altitude of about 1,500 ft. he proceeded to stall the machine several times. He pulled the nose of the machine up until the passengers seemed to be lying on their backs, and, having steadied the machine, let go of the wheel. The machine rolled very slightly from side to side, and sank very slowly, the nose gradually dropping all the while until a normal attitude had been reached.

Photos International Newsreel and P. & A.

Above: Mr. Handley Page showing Major Brackley of Imperial Airways the slots on the Avro

Below: The Avro stalling over Fokker FVII. Mr. Fokker is at the left with helmet on

A demonstration of lateral control was also given by his giving full aileron to one side, leaving the machine to reach a steep bank, and then whirling the wheel over in the opposite direction, letting go when the ailerons were hard over and not taking control again until the machine had righted herself. Later in the day both the Avro and the Fokker made other flights and simply repeated their previous performances.

The Fokker FVII was fitted with a Napier Lion engine and is very similar to the previous members of the F series. The wing span is 72 ft. 6 in. and the wing area 770 sq. ft. The wing loading is 10.6 lb./sq. ft. and the power loading 18.1 lb./hp.

It is understood that, as a result of these tests, an order has been placed with Handley Page for a set of wings with leading edge slots, aileron slots and slotted flaps for a regular DH34. These wings will be delivered in the fall.

Proposed Airplane Tour

At a recent meeting of the S.A.E. Council, discussion was had of the question of holding an Intercity Airplane Tour for civilian contestants, as had been proposed by various persons, conspicuous among these being Col. Paul Henderson, in charge of the Air Mail for the Post Office Department. The matter had also been considered by the National Aeronautic Association for some time. Vice-president Zimmerman and Councilor Warner of the Society attended the sessions of the National Aeronautic Association at the time the program of competitive events for airplanes this year was considered.

It was the view of the Council that the holding of such a tour as had been proposed, similar in a general way to the Glidden Tour, which was inaugurated in the early days of the automobile industry, would be very helpful in furthering aviation in general and commercial flying in particular. The public lacks knowledge and also confidence in too great a degree with respect to the usefulness and reliability of aircraft. The most feasible way of correcting this condition is to hold events such as that under discussion which will familiarize the public in a not too spectacular and even in a casual way with the practical use of airplanes.

Very few are aware of the amount of flying that is done in this Country, particularly by individuals who own and operate airplanes. The number of civilian aircraft that have been flown to aeronautic race-meets in the "on-to" events has been a continual source of surprise. It is stated that over 30 airplanes are privately owned in Detroit and vicinity at this time. The recent consideration given to organizing a private corporation to operate a line of airplanes between New York City and Chicago, and the interest that has been shown recently by Henry and Edsel Ford in aeronautics generally, have brought to the attention of the Country in an emphatic manner the impending development of organized aircraft operation.

Soon after the Council meeting mentioned, a session of aeronautic engineers was held under the auspices of the Society in New York City and later a conference was held in Detroit to encourage the holding of an airplane tour this year, the following being present: Col. Paul Henderson, Luther K. Bell, traffic manager of the Air Mail Service; W. B. Mayo, chief engineer of the Ford Motor Co.; C. M. Keys, president of the Curtiss Aeroplane & Motor Corp.; W. B. Stout, R. W. Schroeder and Vice Presidents Church and Zimmerman, and General Manager Clarkson of the Society. A committee on ways and means and planning was organized, with the following personnel: H. D. Church, chairman, Carl B. Fritsche, R. W. Schroeder and W. B. Stout.

Considerable interest has been shown in the proposed event by over 50 civilian pilots who have communicated directly with the Society. Further conferences have been held in Detroit recently, these being attended by, in addition to those mentioned above, B. Russell Shaw, executive vice chairman of the contest committee of the National Aeronautic Association, R. H. Upson and M. P. Rumney. The work of formulating rules under which the proposed tour shall be held is being conducted primarily by the Contest Committee of the National Aeronautic Association. It is understood that the route of the tour will be approximately 1200 mi. long. The event would be sanctioned by the National Aeronautic Association and sponsored by suitable organizations in the various localities cooperating with various interested technical bodies.

It is planned to have the tour preceded by an on-to-Detroit event, the latter being similar to such competitions that have been held before; all manner of planes being eligible, with starting-points from any region of the Country. It is understood in a tentative way at least that a suitable cash prize will be awarded for each plane which is flown to Detroit from a point 175 mi. or more distant. The on-to-Detroit preliminary tour is scheduled to begin on Monday, Aug. 31, and end at Ford Airport, Dearborn, Mich., at midnight Saturday, Sept. 5. On the following day, Sunday, the public will be afforded an opportunity to view the machines.

The date proposed for the beginning of the Intercity Tour is Labor Day, Sept. 7. Suitable regulations as to eligibility for this event, of both airplanes and pilots, will, of course, be formulated. In general, it is proposed that the contestants for the Intercity Tour will be selected on a point basis from those who shall have arrived in Detroit in the "on-to" preliminary. The cities now listed to be included in the tour are: Fort Wayne, Chicago, St. Louis, Indianapolis, Dayton, Columbus and Cleveland, the beginning and end of the tour being Ford Airport. Naturally, the success of the tour will depend largely upon the support in the way of local equipment and facilities and finance given by the various cities through which the tour will go. For this reason the list of cities is necessarily subject to change.

International Newsreel Photo

The damaged bow of the R33. The arrow points to the tip of the mooring mast

Russian Program

Reports from France indicate that the Russian Soviet government plans to obtain 1,030 planes during 1925. Five hundred of these will be built in Russia principally in the Junkers factory, 300 will be bought from Fokker and 200 will be bought from different Italian firms.

The Soviet government hopes that by 1926 the Russian aeronautical industry will be sufficiently well established to allow of the building of all the necessary planes within the boundaries of Russia.

Air Mail Plane Proposals

With reference to the Post Office Department's proposal, dated April 16, which was addressed to the several manufacturers of airplanes in the United States, the Department wishes to add the following.

In submitting a sample airplane under the terms of this proposal, contractors will also submit a sealed bid quoting price on the sample airplane which is being submitted. This is in addition to the bid quoting prices on duplicates of this sample airplane in lots of three, ten, twenty-five and fifty, as is called for on page 3 of the proposal blank in question.

A Correction

In the table on page 544 of the May 18 issue, a line covering the Glenn L. Martin Co. was omitted. It should have stated that this company is manufacturing 35 SC1 planes and spares at $1,004,791.25 and 40 SC2 planes and spares at $1,030,311.48 for the Navy, a total of $2,035,102.73.

AIRPORTS AND AIRWAYS

German Air Trust

Commercial airplane service in Germany, Austria, Switzerland, Denmark, Sweden, Danzig, Latvia, Esthonia and Finland were united in one concern under German leadership when the Europa Union Co. was incorporated in Berlin, May 9, with the Junker Air Traffic Co. of Berlin as director of operations.

Although the Russo-German company is not formally included as a member, for technical reasons, it is operated by the Junker company, and the new concern may therefore be regarded as controlling and operating air routes over Central Northern and Eastern Europe, except Poland, Czecho Slovakia and Norway, with branches into Switzerland and Italy.

The sixteen companies involved hitherto have worked together under a loose community of interest agreement, but now they are bound by a hard and fast incorporation whose preliminary capital of 5,000,000 marks will be increased next week to 10,000,000 marks.

The incorporation will enable Germany to make full use of her strategic position as the center of a network of radiating air services.

In pursuance of the same advantage the German Government has just refused to permit British commercial planes not complying with German regulations to fly over German territory, with the exception of one line between Berlin and London.

Germany thus obtains the whip hand in European air services despite the limitations imposed on German commercial machines by the Council of Ambassadors.

Monmouth, Ill.

Two hundred and fifty aviation enthusiasts gathered at the Country Club on May 8 to welcome Carl F. Egge, superintendent of the Air Mail Service, and the group of men who are working so that the mail can fly.

Congressman John C. Allen presided at the program. Monmouth's success in the aviation field, stated Congressman Allen, in opening the evening's program, is largely due to the pioneering efforts of a small group of men who have been working at a sacrifice of time and money to make the Mid-West Airways Corp. a real commercial enterprise. Mr. Allen introduced the directors of the corporation, who are largely responsible for its success: I. F. Dains, Charles Buchanan, Chet Jenks, Chet Smith, Fred Pattee, Tom Hewitt and E. P. Field.

I. F. Dains, president of the Mid-West Airways Corp., was called on to introduce some of the visitors who came to Monmouth to attend the dinner. Mr. Dains introduced the following guests to those present: Mrs. Carl F. Egge and Miss Doris Egge, the wife and daughter of the superintendent of the Air Mail Service, who came from Omaha; Mrs. Harry G. Smith, Mrs. O. C. Wilke and Mrs. Hempel, all of whom came to this city with their husbands when the Development Field was opened. W. L. Gilmore, chief engineer of the Curtiss Aeroplane & Motor Corp., who is responsible for the design and construction of many of the racing machines built by the Curtiss Co.; Charles J. Wurtz, also from the Curtiss factory; Maj. M. L. Bromberg, a member of the Aircraft Production Committee of the Illinois Manufacturers' Association and one of Chicago's leading aviation enthusiasts; Lieut. W. H. Houston, of Rushville, a former Army pilot, and John Livingston, pilot-manager of the Mid-West Airways Corp.

Members of the Air Mail Service present at the dinner were introduced by their chief, Carl F. Egge, superintendent of the Air Mail who came from Omaha to be present. Mr. Egge, on behalf of Postmaster General Harry S. New and Col. Paul Henderson, Second Assistant Postmaster General, expressed thanks to Monmouth for the friendly way in which the Air Mail's new enterprise here had been received.

Mr. Egge then introduced the Air Mail officials present, starting with Harry G. Smith, superintendent of the Air Mail Development Division, who volunteered to leave his position as superintendent of the Mountain Division at Cheyenne to take up the work at Monmouth. Mr. Smith was described as the man "with the greatest vision in the Air Mail Service" by Mr. Egge.

O. C. Wilke, assistant superintendent of the Development Division, was described as being one of the most versatile men in the Service in the care and operation of engines. Mr. Hempel, the radio man stationed here, was introduced and his work outlined by Mr. Egge. The Air Mail Service maintains a private radio net between New York and San Francisco with 15 stations. The officials have found radio to be more dependable than the regular commercial wires, and it is possible to get a reply from a message sent to San Francisco from Washington in less than 15 min.

Mr. Bausman, who will have charge of the engine work here, was described as being one of the best Liberty engine mechanics in the country. Eddie Richards, superintendent of the field at Maywood, was introduced by Mr. Egge, who told that the ships built under Mr. Richards' supervision were the best in the country.

Luther K. Bell, "traffic manager" of the Air Mail Service, was introduced as the man who sold the idea of the value of speed in transportation of mail to manufacturers, merchants and bankers. Frank Burnside, official Air Mail test pilot, who will work out of Monmouth Development Field, was also introduced by Mr. Egge, who told of the decision of the department to get a ship that would carry twice as much as the old rebuilt DH4.

The Aerial Mercury, the second of the airplanes to be submitted in the Air Mail competition, was brought from Maywood Field, Chicago, May 11 by Frank Burnside, official Air Mail test pilot. The plane left Chicago at 9:30 o'clock and arrived at the Development Field here at 11:14 o'clock. It will be put through a long series of tests at the local field.

Italian Near East Route

A convention between the Italian Government and the Aero Espresso Italiana for the operation of a commercial air service between Italy and Greece and Turkey has been approved by a royal decree published in the Italian Official Gazette of April 6.

The Aero Espresso Italiana is an Italian company organized to undertake commercial air transportation between Italy and the Near East. It has negotiated conventions with Greece and Turkey for landing stations in those two countries, but has not yet been able to secure permits to land at Saloniki and Smyrna. Until these are obtained it is intended that the itinerary between Athens and Constantinople will follow a route via Lemnos.

The Italian Government engages to pay the company an annual amount of 800,000 lire as subvention, and the company is authorized to utilize this contribution as guaranty for bonds it may issue. For purposes of this subvention the length of the one-way trip between Brindisi, Athens, Lemnos and Constantinople will be computed at 1,437 km. (893 mi.).

The company also obligates itself to maintain its fleet in an efficient condition, by which it is meant that 50 per cent of its airplanes will always be held in readiness with complete crews to make flying trips on request of the air commissioner.

Haskelite Address

In order to give their Eastern customers and prospects better service the Haskelite Manufacturing Corp. have opened a branch office at the following address: Room 1139, 152 West 42nd Street, New York City, N. Y. Telephone, Wisconsin 7274. Their Eastern representative, James J. Dunne, will be in charge of this New York office.

UNITED STATES AIR FORCES

U. S. ARMY AIR SERVICE

Logan Field Cross-Country

On May 30, eight of the planes of the 29th Division Air Service will take off for a 250 mi. cross-country trip over the Eastern Shore. Each plane will have a crew of one officer and one enlisted man. The pilot of Plane No. 1 will be given the following order. "At 9.00 you will leave Logan Field and land at ——— at ——— o'clock. You will receive further orders when you arrive." The orders will send him on a new trip, all on scheduled time allowing him a 10 min. interval to figure out his course and get off. The same scheme will be carried on and five cities on the Eastern Shore will be visited. Plane No. 2 will leave Logan Field under sealed orders 15 min. after No. 1 and so on, until eight planes are under way, all following the same course but not knowing where this course will lead them.

Each team must keep to scheduled time. It must get off on time and land on time. The team which comes nearest to the established schedule wins first prize; the next best, second and so on. Here are the prizes which the *Baltimore American* offers.

	Officers	*Enlisted Men*
First	$350	$150
Second	250	100
Third	150	50

An officer to be eligible must have his correspondence course finished by May 30. The eight pilots will be chosen on the basis of their past performance. This includes, attendance record, devotion to duty, flying efficiency and the general character of his work. As to enlisted men, the first requirement is three recruits by May 30. The eight men to enter the contest as mechanics will then be chosen on the basis of their record in the squadron. Attendance will count heavily.

New Airplane Detectors

Rush orders have been issued by the War Department to Frankford Arsenal for the manufacture before June 1 of eighteen sets of a new type of sound-locating device intended for detection of aircraft at considerable distances.

The order is in connection with the army program for extensive special target firing this summer at aerial targets to get accurate information as to the effectiveness of anti-aircraft guns of all types. The test firing is already in progress at posts in New York State and will be conducted also at San Francisco, Honolulu and the Panama Canal Zone.

The new sound-locating device is known as the "exponential horn," and preliminary experiments indicate that it will have a range of eight miles in daytime. Present locating devices are technically styled "telesitometers," which employ a different principle for spotting the distant rumble of aircraft motors. The new device is expected to show greater accuracy as well as greater range than the present equipment.

Miller Field Meet

The Second Annual Aviation Meet of the 27th Division Air Service, New York National Guard will be held on Saturday, June 20, 1925, at Miller Field, New Dorp, Staten Island, N. Y. The Meet will be open to both civilian and U. S. Air Service pilots. The preliminary list of events follows.

1. Formation Flight. 1st and 2nd Prizes—Silver cups to winning formations.

2. Seaplane Race. 30 mi. 1st, Prize—Gold Watch—2nd Prize Silver Cigarette Case.

3. Landing to a Mark. Throttles closed at 500 ft. Each plane, 3 trials. 1st Prize Gold Watch. 2nd Prize, Silver Cigarette Case.

4. Altitude Race (Open) 1st Prize, Gold watch. 2nd Prize, Silver Cigarette Case.

5. Combat between airplanes and tanks. (Demonstration.)

6. Aerial Combat. (Demonstration.)

7. DH Speed Race. (30 mi.) 1st Prize, Gold Watch. 2nd Prize, Silver Cigarette Case.

8. Sky Writing. (Demonstration.)

9. National Guard Speed Race. (30 mi.) 1st Prize, Gold Watch. 2nd Prize, Silver Cigarette Case.

10. Stunt Flying. 1st Prize, Gold Watch. 2nd Prize, Silver Cigarette Case.

11. Open Speed Race. (30 mi.) 1st Prize, Gold Watch. 2nd Prize, Silver Cigarette Case.

12. Relay Race Mixed Types. (30 mi.) 3 planes. 1st Prize, Three Gold Watches. 2nd Prize, Three Silver Cigarette Cases.

13. Parachute Jumping. 1st Prize, Gold Watch. 2nd Prize, Silver Cigarette Case.

14. On to Miller Field. 1st Prize, Silver Cup to organization sending greatest number of planes. 1st Prize, Silver Cup to Field flying greatest distance.

Note: If third prizes are to be given this will be noted in formal announcement of events which will accompany entry blanks. Events to start promptly at 11:00 a. m., and to finish at 6:00 p. m.

Army Air Orders

Maj. Carl Spatz, A.S., Langley Field, to Washington.

First Lt. Clarence B. Lober, A.S., Mass. Inst. Tech., Cambridge, to Brooks Field.

First Lt. Ames S. Albro, A.S., Washington, to temporary duty Kelly Field, upon its completion to San Francisco, sailing Nov. 20 for the Philippine Islands.

First Lt. Raphael Baez, jr., A.S.,, Dayton, to Chanute Field.

First Lt. Angier H. Foster, A.S., Dayton to Brooks Field.

First Lts. Lewis R, P. Reese and Edwin R. Page and Sec. Lt. Donald B. Phillips, A.S., A.S. Eng. School, Dayton, to Com. Off., Brooks Field.

First Lt. George E. Hodge, A.S., Of. Ch. A.S., to A. S. Tact. Sch., Langley Field, for instruction.

Maj. Harold S. Martin, A.S., Chicago, to McCook Field.

Lt. Col. Clarence C. Culver, A.S., designated as commandant A. S. Adv. Fly. Sch., Kelly Field.

Vice Lt. Col. James E. Fechet, A.S., now brigadier general assistant to Ch. A.S., relieved from duties as commandant A.S. Adv. Fly. Sch., Kelly Field.

Staff Serg. Boyd R. Ertwine, 11th Sch. Gr. headquarters, A.S., Brooks Field, transferred to 60th Serv. Squad., A.S., Kelly Field.

Staff Serg. Robert E. Romelsbacher, 60th Serv. Squad., A.S., Kelly Field, transferred to 11th Sch. Gr. headquarters, A.S., Brooks Field.

U. S. NAVAL AVIATION

Midshipmen to be Aviators

Following the decision of Secretary of the Navy Wilbur to put into effect at the United States Academy the recommendations of Jan. 17, 1925 of the Special Board on Aviation to make aeronautics a major subject there, practical steps are being taken to begin at once preparations for carrying out the order that was issued. Lieut. B. R. Holcombe, U.S.N., on duty in the Bureau of Aeronautics, left for Annapolis May 8 to confer with the Superintendent of the Naval Academy, and the heads of the departments on the practical operation of the new plan. Extension of the present aero-

nautical subjects already being taught at the Academy to include a complete "ground course" will be planned while Lieutenant Holcombe is at Annapolis.

To date the four year course at the Naval Academy has devoted 31.5 hr. of instruction to aviation direct, while 254.5 hr. have been devoted to the study of subjects which are vitally essential to the training of military aviators. With the exception of the actual operation of airplanes, the midshipmen have, for the last few years, been given as thorough a course in the sciences on which aviation is based than is given in any other school in the United States which trains aviation pilots. Subjects vital to the training of competent aviators, such as meteorology, gunnery, navigation, piloting, ship handling, radio, communications, engineering and maneuvering are taught at the Naval Academy during the entire course. Physical development, so necessary a part of an aviator's requirements, is kept uppermost in the mind of every midshipman, and probably a larger percentage of young men physically qualified for aviation duties will be found at the Naval Academy than in any other institution in the country.

Aeronautics in one form or another has been taught in the Department of Seamanship, Ordnance and Gunnery, Navigation, Marine Engineering and Naval Construction, Mathematics, Electrical Engineering, and Physics. In the last named department, a total of 111 hr. are devoted to the study of the theory of flight, to radio, both general radio and aircraft radio, and to all subjects under the science of physics which are essential to a thorough knowledge of aeronautics. Among these are, fundamental units, density and specific gravity, essential in the study of atmosphere and lifting gases, hydrogen and helium; pressure in fluids and pressure in air; essential to aerostatics in determination of airship lift and resistance; gravitation and equilibrium, resolution of forces, necessary for an understanding of stability of airplanes; work, power, energy, specific heat, evaporation, heat transfer and thermodynamics—all essential to the study of aerology.

In the Department of Marine Engineering and Naval Construction studies and practical drills are given, for a total of 18 hr., in airplane engines, carburetors and magnetos. For this purpose, there are in use four different types of airplane engines, both air-cooled and water-cooled.

Thirty-two hours have been devoted to aerial navigation, piloting, and general navigation. This is one of the most important requirements of aviators, either military or civil.

In the Department of Ordnance and Gunnery, sixty-seven and one half hours have been devoted to the study of aircraft guns, machine guns, aerial gunnery and bombdropping. Defense against aircraft forms a part of this course and a great part of the time is devoted to a study of bombs, torpedoes, mines, and the science of ballistics, that part of ordnance which deals with the manufacture and application of explosives and their use in every type of gun used in the military service.

In the past seventeen and one half hours have been devoted in the Department of Seamanship to the study of strategy and tactics as applied to aviation, and include a study of the various types of airplanes and the problems arising from their use with naval vessels. Under this department are included the important studies of communication, signals, war instructions, laws of storms and aerology, and weather signals.

Forty hours have been devoted to Mechanics which is a fundamental subject in the education of aviators.

All the above, which has been a part of the regular course at the Naval Academy for several years, represents a serious and comprehensive study of the underlying and essential elements of knowledge required by an aviator if he is to be of any use to the Navy as an aviator in time of war, and, if in time of peace, he is to be anything but a pilot who can fly a plane but who would be incapable of adding to the practical and scientific progress of aeronautics.

The new policy inaugurated by the Secretary of the Navy on May 5 wherein aviation is made one of the major subjects at the Naval Academy is a further logical step in giving to the Navy complete knowledge and appreciation of Naval aviation. By the establishment of the Department of Engineering and Aeronautics and of the Department of Seamanship and Flight Tactics, the courses previously in progress, bearing on aviation, will be broadened in scope, and the entire subject of aviation instruction will be established as one of first importance.

With the added theoretical instruction in aviation will go, under the new plan, added practical experience in ground work and the principle of flying, both during the academic year and the three summer months of intensive instruction to members of the first class.

Physical disqualifications which will necessarily prevent some graduates from flying will be the only bar to eventually qualifying all junior officers as either pilots or observers after final qualifying courses at such training centers as Pensacola and San Diego.

Big Business Flies

The Los Angeles, under command of Capt. George W. Steele, took off at 11:31 May 15, the object of the trip being to enable the members of the Advisory Board to visualize the Philadelphia area. Over several places the big airship was flown within a few hundred feet of the ground, the passengers resting comfortably on upholstered seats in the cabin.

The start was made in a slight rain. The passengers wore light overcoats and as soon as the rain ceased the windows of their cabin were opened.

Graham McNamee of the Station WEAF broadcast a description of the flight and introduced to radio listeners several of the prominent men on board. Several of these gave brief talks, expressing their satisfaction over the cruise.

The Los Angeles carried a crew of twenty-eight officers and men besides the thirty-three passengers, the largest complement that has ever ridden in her. A course dinner, prepared in the galley of the ship, was served while flying high over Pennsylvania.

The airship came to the ground riding easily at 6:34 p. m.

New Naval Bombers

The Navy Department has adopted a program of development in new and additional types of bombing planes for use on the aircraft carriers now under construction, the U.S.S. Saratoga and U.S.S. Lexington, and the need for which has been pointed out by higher officers of the fleet.

Bids have been received for a single engine plane to be built around the Packard "2500 engine." The details of this plane are confidential. If an award is made on these bids, the plane will be assembled at the Naval Aircraft Factory, Philadelphia.

These bids will be followed by requests for bids for a twin-engine plane to be built around the Wright "Cyclone" air-cooled engine recently developed and tested in a flight from Paterson, N. J., to Washington.

Experiments with these two planes are expected to go far in determining the new type of planes for the carriers and not until this decision is made, will planes for the carriers be built in quantity.

Naval Air Orders

Lt. William D. Thomas det. command Nav. A. Sta., Anacostia, to Aircraft Squads., Sctng. Ft.

Ch. Gun. Jack K. Campbell det. Nav. A.S., San Diego, to U.S.S. Corry.

Gun. Warren C. Carr det. Nav. A. S., San Diego, to U.S.S. Corry.

Ch. Pay Clerk Charles T. Stanworth det. Nav. A. S., N.O.B. Hampton Roads, to 16th Nav Dist.

Ens. Eugene L. Monagin det. U.S.S. Marcus to temp. duty Nav. A. S., Pensacola.

Ens. Albert C. Murdaugh det. U.S.S. Colorado to temp. duty Nav. A. S., Pensacola.

Ens. Robert H. Rodgers, det. U.S.S. Utah to temp. duty, Nav. A. S., Pensacola.

Ens. Richard S. Waggoner det. U.S.S. Fulton to temp. duty Nav. A. S., Pensacola.

Lt. Ralph H. Howard det. Nav. A. S., Anacostia ,to Nav. A. S., D. C.

Ens. Vernon C. Clapp det. Nav. A. S., Pensacola, to U.S.S. West Virginia.

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HUNTINGTON WEST VIRGINIA

Publisher's News Letter

There have been some enquiries regarding a commercial exhibition of aircraft ths year. Location plays a very important part in any aircraft meet. The western constructors do not care to fly such a long distance as across the continent or even half way. Those in the middle west do not relish crossing the Rockies or the Alleghanies. There therefore seems to be three distinct groups to consider when planning for any proposed meet. If held in the east the exhibitors might be limited to those constructors east of Detroit with a very few exceptions unless large prizes or other inducements were offered. A middle west show would attract much the same group as was to be seen in the "Hell's Half Acre" at St. Louis and Dayton. California seems out of the range of possibilities for present commercial planes to visit for exhibition purposes.

* * * *

The manufacturers who have done the most to advance commercial flying are located for the most part in the states west of the Alleghanies—Advance Aircraft Co., Troy, Ohio; Yackey Aircraft Co., Forest Park, Ill.; Johnson Airplane & Supply Co., Dayton, Ohio; Lincoln-Standard Aircraft Co., Lincoln, Nebr.; The Swallow Airplane Manufacturing Co., Wichita, Kans.; Travel Air Inc., Wichita, Kans., and the Stout All-Metal Airplane Co., Detroit, Mich. In the east there are Curtiss and Remington-Burnelli on Long Island, and Huff-Daland at Ogdensburg, N. Y.

For the middle-western manufacturers (who with one or two exceptions are not represented in the east with planes) the Alleghanies offer a physical objection, but one which they would probably not consider especially important if the inducements of publicity, prizes or possible sales in the east were sufficiently attractive.

* * * *

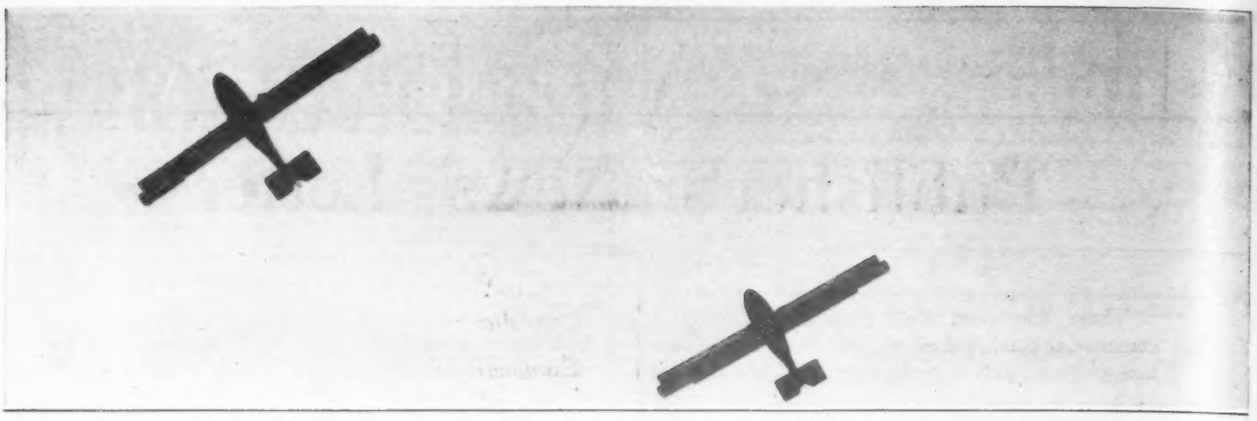
Those conversant with conditions at the previous military controlled national meets would first have to be thoroughly convinced that a commercial show could be held without official interference or Government red tape. Curtiss or Roosevelt Fields have been suggested for a commercial show coincident with the military events at Mitchel Field. The question arises, could the crowd in sufficient numbers be drawn to a separate commercial show. From the standpoint of the public the high speed, bombing or fighting planes of the Army and Navy offer the spectacular interest which attracts the crowd. However, the crowd is not yet a customer for commercial aircraft. Under present conditions the real customer is the air enthusiast, the sportsman and pilots who are looking for better performing two or three-place ships, and those who are studying the possibilities of larger transport planes. To these people, the military races would be merely incidental. Full opportunity for flying demonstrations and pay passenger business would of course have to be extended to the commercial manufacturers.

* * * *

In the strictly commercial and pioneer cabin transport class, ships such as the Yackey Breguet, the Remington-Burnelli Airliner, the Sikorsky transport and the Stout all-metal Pullman, form the real nucleus of our future air carriers. Taken with the newly designed mail planes of Curtiss, Boeing, Douglas, Elias and Aerial Service Corporation, the new OX three-place ships and a few sport types, an excellent commercial show could be gotten together which, class for class, would compare most favorably with anything the subsidized air industry of Europe could offer. By all means, plans should be pushed forward now for the most representative strictly commercial show that can be gotten together during this year.

* * * *

Commercial aviation is the hope of the aeronautical industry. Interest in its future on the part of the public is here and should be capitalized now. The real question is where should such a show be held to benefit most the constructors who, without any assistance in the form of government business or otherwise, have with everlasting *doggedness* in the face of great discouragement and indifference actually built and demonstrated to the public the possibilities of air transportation. If this year an eastern show, either incidental or entirely separate from the National Air Races, could be made a part of the itinerary of the projected traveling show of commercial aircraft, it would appear to us an ideal solution from the standpoint of the commercial manufacturers.



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GOODYEAR

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The Aircraft Service Directory

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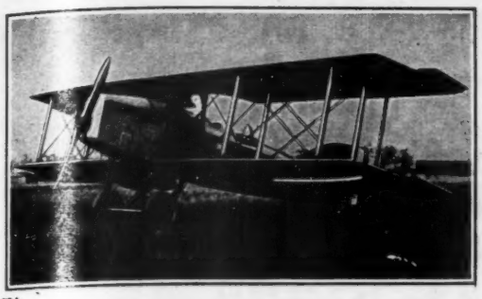

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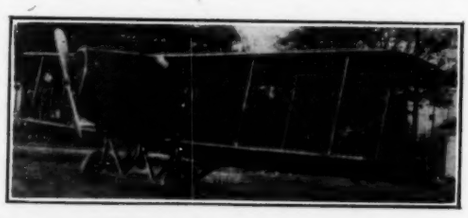

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INDEX TO ADVERTISERS

A

Advance Aircraft Co. 589
Aircraft Development Co. 590
Aircraft Service Directory 585-586
Aircraft Supply Co. 586
Anderson Aircraft Manufacturing Co. 585
Angle, Glenn D. 585

C

Chicago Aviation Co. 590
Classified Advertising 586
Curtiss Exhibition Co. 568

D

Decatur Aircraft Co. 586

G

Goodrich Rubber Co., The B. F. 566
Goodyear Tire & Rubber Co. 584

H

Hamilton Aero Mfg. Co. 585
Hartney, Harold Evans 586
Haskelite Manufacturing Co. 586
Huff Daland Aero Corp. 585

I

Ireland, G. S. 585

J

Johnson Airplane & Supply Co. 590
Johnson Motor Products Co. 585

L

Lamblin, Etablissements 587
Lincoln Standard Aircraft Corpn. 585
Logan, Floyd J. 587
Ludington Exhibition Co., Inc. 589

M

Martin, Glenn L., Co., The 588
Monumental Aircraft Co. 585

N

Northrop, Marvin A. 587

P

Pander & Zonen, H. 567
Peck, Allen E. 585
Phenix Aircraft Products Co. 586
Pioneer Instrument Co. 585

R

Rinehart-Whelan Co. 587

S

Smith, J. Warren 585
Southern Airways, Inc. 586
Spalding Construction Co. 586
Summerill Tubing Co. 587

T

Titanine, Inc. 587

W

Wallace Aero Co. 585
Warner, Edward P. 585
Where to Fly 582
Wood Elastic Web Co., J. W. 587
Wright Aeronautical Corp. 592

Y

Yackey Aircraft Co. 585

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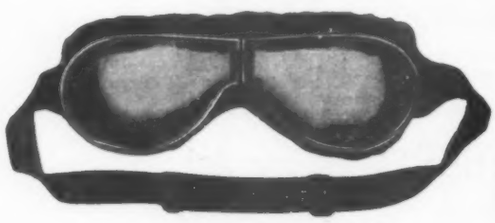

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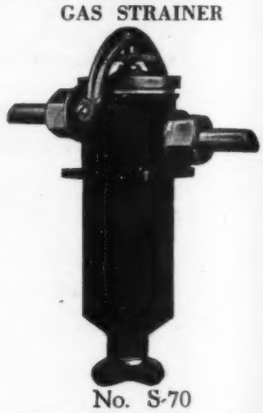

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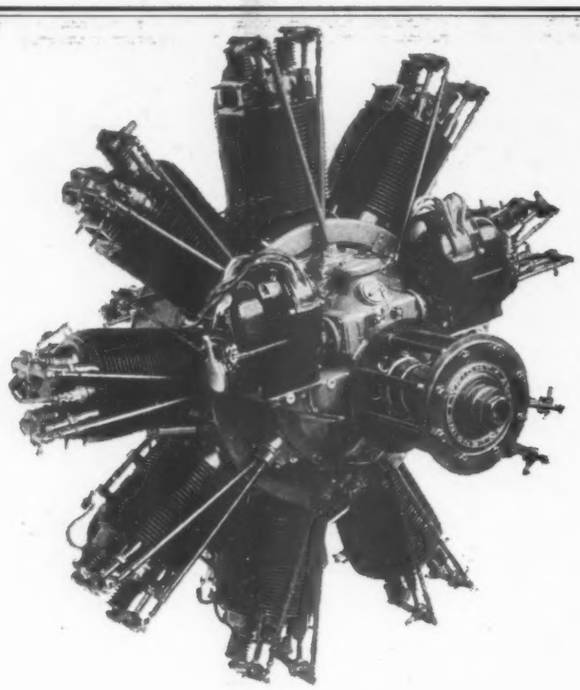

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